

WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTERS
PATENT OF THE UNITED STATES IS:

1. A method of manufacturing a footwear structure, comprising:
overlying at least two material layers such that the at least two material layers are in contact with one another;
heating the at least two material layers to a forming temperature; and
vacuum-forming the at least two material layers together to form a composite material layer into a three-dimensional form of the footwear structure.
2. The method of Claim 1, wherein the at least two material layers are permanently attached after the vacuum-forming step.
3. The method of Claim 1, wherein the at least two material layers are separable after the vacuum-forming step.
4. The method of Claim 1, wherein at least one of the at least two material layers is a thermoplastic or a thermoset.
5. The method of Claim 4, wherein all of the at least two material layers are made of thermoplastic polyurethane.
6. The method of Claim 1, wherein one of the at least two material layers is a textile layer.
7. The method of Claim 1, wherein one of the at least two material layers is a leather layer.
8. The method of Claim 1, wherein one of the at least two material layers is porous relative to another one of the at least two material layers.
9. The method of Claim 1, wherein one of the at least two material layers is smaller in size than another one of the at least two material layers.
10. The method of Claim 1, further comprising:
providing a positive air pressure against the at least two material layers during the

vacuum-forming step.

11. A method of manufacturing a footwear structure, comprising:

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positioning a first material layer and a second material layer on a forming surface of a molding device, wherein the second material layer is positioned between the first material layer and the forming surface, and wherein the forming surface has a predetermined shape; and

drawing the first and second material layers toward the forming surface such that the first and second material layers conform to a shape of the forming surface.

12. The method of Claim 11, wherein the first and second material layers permanently adhere to one another during the drawing step.

13. The method of Claim 11, further comprising:

separating the first and second material layers after the drawing step, wherein the first and second material layers do not permanently adhere to one another during the drawing step.

14. The method of Claim 11, further comprising:

heating at least one of the first and second material layers to a forming temperature prior to at least one of the positioning and drawing steps.

15. The method of Claim 14, wherein the heating step including heating different portions of at least one of the first and second material layers to different temperatures.

16. The method of Claim 14, wherein the heating step including heating the forming surface.

17. The method of Claim 11, wherein the drawing step includes evacuating air between the first and second material layers.

18. The method of Claim 17, wherein the drawing step includes creating a vacuum in an interior space of the molding device.

19. The method of Claim 11, wherein the drawing step includes forcing the first and second material layers toward the forming surface with an external air pressure.

20. The method of Claim 11, wherein the drawing step includes forcing a portion of at least one of the first and second material layers toward the forming surface with an external plug component.

21. The method of Claim 11, wherein the forming surface is arranged as a male molding surface or a female molding surface.

22. The method of Claim 11, wherein the forming surface includes a surface texture that is transferred to a surface of at least one of the first and second material layers during the drawing step.

23. The method of Claim 11, wherein the forming surface includes an embossed design that is transferred to a surface of at least one of the first and second material layers during the drawing step.

24. The method of Claim 11, wherein the second material layer is porous with respect to the forming surface.

25. The method of Claim 11, wherein at least one of the first and second material layers is made of a thermoplastic or a thermoset material.

26. The method of Claim 25, wherein at least one of the first and second material layers is made of thermoplastic polyurethane.

27. The method of Claim 11, wherein the first and second material layers are made of different materials.

28. The method of Claim 11, wherein the first and second material layers are made of the same material.

29. The method of Claim 11, wherein the second material layer is smaller in surface area than the forming surface.

30. The method of Claim 11, further comprising:

attaching the second material layer to the first material layer before the drawing step.

31. The method of Claim 11, wherein the second material layer is a rigid component

prior to the drawing step.

32. The method of Claim 11, wherein the second material layer includes an embossed design.

33. The method of Claim 11, wherein,
the forming surface includes a first recessed area, and
the drawing step forms in at least one of the first and second material layers a second recessed area corresponding to the first recessed area.

34. The method of Claim 33, wherein the positioning step includes positioning at least a portion of the second material layer on a surface of the first recessed area.

35. The method of Claim 33, wherein the first recessed area is located on a sidewall portion of the forming surface.

36. The method of Claim 11, wherein an edge portion of the second material layer is received into the first material layer during the drawing step.

37. The method of Claim 36, wherein a surface portion of the first material layer is flush with a surface portion of the second material layer after the drawing step.

38. The method of Claim 11, wherein at least one of the first and second material layers includes a graphic design.

39. The method of Claim 11, wherein at least one of the first and second material layers is transparent.

40. The method of Claim 11, wherein at least one of the first and second material layers is translucent.

41. The method of Claim 11, further comprising:
coating a portion of the forming surface with a coloring material such that at least a portion of at least one of the first and second material layers is colored during the drawing step.

42. The method of Claim 11, further comprising:

introducing a fluid-filled insert between a portion of the first material layer and a portion of the second material layer before the drawing step.

43. The method of Claim 11, further comprising:

trimming a portion of at least one of the first and second material layers after the drawing step.

44. The method of Claim 11, wherein,

the drawing step includes forming a trimming groove in at least one of the first and second layers, and

the trimming step includes trimming at least one of the first and second material layers along the trimming groove.

45. The method of Claim 11, further comprising:

adhering traction components to at least one of the first and second material layers after the drawing step.

46. The method of Claim 45, wherein the traction components are made of a traction-providing material.

47. The method of Claim 11, further comprising:

creating a traction layer on at least one of the first and second layers after the drawing step.

48. The method of Claim 47, wherein the creating step includes spraying a traction-providing material onto at least a portion of at least one of the first and second material layers.

49. The method of Claim 11, further comprising:

applying a graphic design to at least one of the first and second material layers after the drawing step.

50. The method of Claim 11, further comprising:

attaching a lining component to a trimmed edge of at least one of the first and second

material layers.

51. The method of Claim 11, wherein,
the positioning step includes positioning a third material layer against at least one of
the first and second material layers, and
the third material layer conforms to a shape of the forming surface during the drawing
step.

52. The method of Claim 51, wherein the third material layer permanently adheres to
at least one of the first and second material layers.

53. The method of Claim 51, wherein at least a portion of the third material layer is
positioned between the first and second material layers.

54. The method of Claim 51, wherein the third material layer is made of a textile
material.

55. The method of Claim 51, wherein the third material layer is smaller in size than
the forming surface.

56. The method of Claim 51, wherein the positioning step includes positioning the
third material layer directly adjacent to the second material layer on the forming surface to
form a contact seam.

57. The method of Claim 56, wherein the positioning step includes positioning
respective edges of the second and third material layers at the contact seam away from the
forming surface such that the respective edges are received into the first material layer during
the drawing step.

58. The method of Claim 51, wherein,
the first material layer is positioned between the second and third material layers, and
the third layer is removed from the first material layer after the drawing step.

59. The method of Claim 11, wherein the footwear structure is an upper footwear
structure.

60. The method of Claim 11, wherein the footwear structure is a sole assembly.

61. A forming apparatus for creating a footwear structure in a single-sheet thermoforming process, comprising:

- a molding device including,
- a drawing device configured to create a vacuum in an interior space of the molding device, and
- a forming surface acting as a boundary of the interior space, the forming surface including at least one aperture configured to allow air passage and a recessed area, wherein, activation of the drawing device creates a vacuum pressure through the at least one aperture such that a material layer positioned on the forming surface is drawn against the forming surface and a corresponding portion of the material layer permanently assumes the shape of the recessed area, and
- the recessed area is shaped such that the corresponding recessed portion of the material layer provides at least one of cushioning and stiffening for a user.

62. The forming apparatus of Claim 61, wherein the recessed area is positioned in a sidewall portion of the forming surface.

63. The forming apparatus of Claim 61, wherein the recessed area includes a flat support portion, a recess opening, and a recess sidewall connecting the flat support portion to the recess opening.

64. The forming apparatus of Claim 63, wherein the flat support portion is substantially shaped as one of a trapezoid, circle, and triangle.

65. The forming apparatus of Claim 63, wherein the flat support portion includes rounded corners.

66. The forming apparatus of Claim 63, wherein the recess sidewall includes an amount of curvature that extends from the recess opening to the flat support portion.

67. The forming apparatus of Claim 63, wherein the recess sidewall includes an

amount of curvature that extends from the recess opening to a location on the recess sidewall.

68. The forming apparatus of Claim 61, wherein the forming surface includes a trimming groove along a periphery of the forming surface such that a peripheral portion of the material layer assumes a shape of the trimming groove when the material layer is drawn against the forming surface.

69. The forming apparatus of Claim 61, wherein the forming surface includes a embossed design such that a portion of the material layer assumes a shape of the embossed design when the material layer is drawn against the forming surface.

70. The forming apparatus of Claim 61, wherein the molding device is arranged as a male mold.

71. The forming apparatus of Claim 61, further comprising:
a heating device configured to heat the material layer prior to or during positioning of the material layer on the forming surface.

72. The forming apparatus of Claim 71, wherein the heating device is configured to heat different portions of the material layer to different temperatures.

73. The forming apparatus of Claim 72, wherein,
the heating device includes a heating array including a plurality of heating elements,
and
at least two of the heating elements are configured to achieve different maximum temperatures.

74. A footwear structure comprising:
an upper; and
a sole assembly attached to the upper, the sole assembly including a first material layer made of a thermoplastic, and a second material layer attached to the first material layer,
wherein,
the first material layer includes a recessed area including a flat support portion,

the first material layer is transparent or translucent,
at least a portion of the second material layer is positioned on a surface of the recessed area, and
a color of the second material layer indicates at least one of a location and a function of the second material layer.

75. The footwear structure of Claim 74, wherein the second material layer is heat-bonded and vacuum-bonded to the first material layer.

76. The footwear structure of Claim 74, wherein at least one of the first and second material layers is made of a thermoplastic or a thermoset.

77. The footwear structure of Claim 76, wherein at least one of the first and second material layers is made of thermoplastic polyurethane.

78. The footwear structure of Claim 74, wherein the recessed area is configured to provide one of cushioning and stability for a user.

79. The footwear structure of Claim 74, further comprising:
a moderating component positioned between the sole assembly and the upper,
wherein the moderating component is supported by the flat support portion of the recessed area.

80. The footwear structure of Claim 74, wherein the sole assembly further includes a third material layer attached to a sidewall portion of the first material layer, the third material layer being configured to provide stability for a user.

81. The footwear structure of Claim 80, wherein the third material layer is heat-bonded and vacuum-bonded to the first material layer.

82. A footwear structure comprising:
an upper; and
a sole assembly attached to the upper, the sole assembly including a first material layer made of a thermoplastic, and a second material layer heat-bonded and vacuum-bonded

to the first material layer, wherein,

the first material layer includes a recessed area being configured to provide one of cushioning and stability for a user, and

at least a portion of the second material layer is positioned on a surface of the recessed area.

83. The footwear structure of Claim 82, wherein the recessed area include a flat support portion.

84. The footwear structure of Claim 83, wherein the flat support portion is substantially shaped as one of a trapezoid, circle, and triangle.

85. The footwear structure of Claim 83, wherein the flat support portion includes rounded corners.

86. The footwear structure of Claim 82, wherein the sole assembly includes a third material layer heat-bonded and vacuum-bonded to the first material layer, wherein the third material layer is positioned on a sidewall portion of the first material layer.

87. An upper footwear structure comprising:

a first material layer made of a thermoplastic; and

a second material layer heat-bonded and vacuum-bonded to the first material layer.

88. The upper footwear structure of Claim 87, wherein at least one of the first and second material layers is porous.

89. The upper footwear structure of Claim 88, wherein the second material layer is made of a thermoplastic.

90. The upper footwear structure of Claim 87, wherein the second material layer is smaller in size than the first material layer.

91. The upper footwear structure of Claim 87, wherein the first material layer includes a recessed area formed from the first material layer and shaped to provide at least one of cushioning and stiffening for a user.

92. The upper footwear structure of Claim 91, wherein the recessed area includes a flat support portion.

93. The upper footwear structure of Claim 91, wherein at least a portion of the second material layer is positioned on a surface of the recessed area.

94. The upper footwear structure of Claim 87, wherein at least a portion of the second material layer is recessed into the first material layer.

95. The upper footwear structure of Claim 94, wherein a surface portion of the first material layer is substantially flush with a surface portion of the second material layer.

96. The upper footwear structure of Claim 87, further comprising a third material layer at least one of heat-bonded and vacuum-bonded to at least one of the first and second material layers.

97. The upper footwear structure of Claim 96, wherein at least a portion of the third material layer is positioned between the first and second material layers.

98. The upper footwear structure of Claim 96, wherein the third material layer is made of a textile material.

99. The upper footwear structure of Claim 96, wherein the third material layer is smaller in size than the first material layer.

100. The upper footwear structure of Claim 96, wherein the third material layer is positioned directly adjacent to the second material layer on the first material layer at a contact seam.

101. The upper footwear structure of Claim 100, wherein respective edges of the second and third material layers at the contact seam are positioned toward the first material layer such that the respective edges are recessed into the first material layer.

102. The upper footwear structure of Claim 87, wherein at least one of the first and second material layers is transparent or translucent.

103. The upper footwear structure of Claim 91, wherein the recessed area is

configured to interface with a protruding area of another footwear structure.

104. A sole assembly, comprising:

a first material layer made of a thermoplastic, wherein,
the first material layer includes a recessed area formed from the first material layer,
and
the recessed area includes a flat support portion, a recess opening on a first surface of the first material layer, and a recess sidewall connecting the flat support portion to the recess opening.

105. The sole assembly of Claim 104, wherein the recessed area is positioned in a sidewall portion of the sole assembly.

106. The sole assembly of Claim 104, wherein the flat support portion is substantially shaped as one of a trapezoid, circle, and triangle.

107. The sole assembly of Claim 104, wherein the flat support portion includes rounded corners.

108. The sole assembly of Claim 104, wherein the recess sidewall includes an amount of curvature that extends from the recess opening to the flat support portion.

109. The sole assembly of Claim 104, wherein the recess sidewall includes an amount of curvature that extends from the recess opening to a location on the recess sidewall.

110. The sole assembly of Claim 104, wherein the flat support portion is configured to support a moderating component.

111. The sole assembly of Claim 104, wherein the recess opening is configured to interface with a protruding area of another footwear structure.

112. The sole assembly of Claim 104, wherein the first material layer is transparent or translucent.

113. The sole assembly of Claim 104, wherein the first material layer includes a toe tab portion configured to attach to and to prevent damage to an upper footwear structure.

114. The sole assembly of Claim 104, further comprising:
a second material layer heat-bonded and vacuum-bonded to the first material layer.
115. The sole assembly of Claim 114, wherein at least a portion of the second material layer is positioned in at least a portion of the recessed area.
116. The sole assembly of Claim 114, wherein at least a portion of the second material layer is positioned on a sidewall portion of the sole assembly.
117. The sole assembly of Claim 114, wherein the second material layer is made of a thermoplastic.
118. The sole assembly of Claim 114, wherein the second material layer is colored to indicate at least one of location and function of the second material layer.
119. The sole assembly of Claim 104, including a forefoot area and a heel area.
120. The sole assembly of Claim 119, wherein,
the forefoot area includes a plurality of axial recesses arranged along a longitudinal axis of the forefoot area, and
the heel area includes a plurality of heel recesses, wherein the recessed area is one of the peripheral, axial, and heel recesses.
121. The sole assembly of Claim 120, wherein the forefoot area includes a plurality of peripheral recesses, and the axial recesses are positioned between two areas of peripheral recesses.
122. The sole assembly of Claim 121, wherein,
each peripheral recess includes a recess opening on a first surface of the first material layer, and
a width of each peripheral recess measured on the first surface decreases from an interior portion of the first surface to an edge of the first surface.
123. The sole assembly of Claim 104, wherein,
the forefoot portion includes a first tread area, and

the heel portion includes a second tread area .

124. The sole assembly of Claim 104, wherein the axial recesses are surrounded by the first tread area.

125. The sole assembly of Claim 104, wherein the recess opening is adjacently surrounded by a peripheral groove.

126. The sole assembly of Claim 104, wherein, the recessed area includes a protrusion extending from the flat support portion toward the recess opening, and

the protrusion is configured to allow for removal of ground matter accumulated in the recessed area during usage of the sole assembly.

127. The sole assembly of Claim 104, further comprising:

a forefoot area having a plurality of radial channels and a plurality of elliptical channels, wherein each of the radial channels is connected to at least one of the elliptical channels to provide deflection of the forefoot area and to allow heat dissipation across the forefoot area; and

an instep portion having a plurality of latitudinal channels arranged to provide deflection of the instep portion and to allow air flow across the instep portion.

128. The sole assembly of Claim 127, further comprising:

a heel area having a second plurality of radial channels and a second plurality of elliptical channels, wherein each of the second radial channels is connected to at least one of the second elliptical channels to provide deflection of the heel area and to allow heat dissipation across the heel area.

129. The sole assembly of Claim 127, further comprising:

a heel area having a plurality of semi-circular channels positioned along a periphery of the heel area, wherein the semi-circular channels are arranged to provide deflection of the heel area and to allow heat dissipation across the heel area.

130. The sole assembly of Claim 104, further comprising:
a groove extending from a first edge of the first material layer to a second edge of the first material layer.

131. The sole assembly of Claim 104, wherein the recess sidewall is planar from the recess opening to the flat support portion.

132. The sole assembly of Claim 108, further comprising:
a second recess sidewall that is planar from the recess opening to the flat support portion.